and waited until the deer was water-logged. Their prey being thus rendered heavy and short-winded, would fall an easy victim if induced to run sufficiently far,—*i.e.* if prevented from entering the jungle. It was, of course, impossible to estimate the number of jackals engaged in this hunt, for it is not unlikely that, as soon as one had done duty at one place, it outran the deer to await it in the another.

A native servant, who accompanied my friend, told him that this was a stratagem habitually employed by the jackals in that place, and that they hunted in sufficient numbers "to leave nothing but the bones." As it is a stratagem which could only be effectual under the peculiar local conditions described, it must appear that this example of collective instinct is due to "separate expression," and not to "inherited habit."

Cases of collective instinct are not of infrequent occurrence among dogs. For the accuracy of the two following I can vouch. A small skye and a large mongrel were in the habit of hunting hares and rabbits upon their own account, the small dog having a good nose and the large one great fleetness. These qualities they combined in the most advantageous manner, the terrier driving the game from the cover towards his fleet-footed companion, which was waiting for it outside.

The second case is remarkable for a display of sly sagacity. A friend of mine in this neighbourhood had a small terrier and a large Newfoundland. One day a shepherd called upon him to say that his dogs had been seen worrying sheep the night before. The gentleman said there must be some mistake, as the Newfoundland had not been unchained. A few days afterwards the shepherd again called with the same complaint, vehemently asserting that he was positive as to the identity of the dogs. Consequently, the owner set one watch upon the kennel, and another outside the sheep-enclosure, directing them (in consequence of what the shepherd had told him) not to interfere with the action of the dogs. After this had been done for several nights in succession, the small dog was observed to come at daydawn to the place where the large one was chained: the latter immediately slipped his collar, and the two animals made straight for the sheep. Upon arriving at the enclosure the Newfoundland concealed himself behind a hedge, while the terrier drove the sheep towards his ambush, and the fate of one of them was quickly sealed. When their breakfast was finished the dogs returned home, and the large one, thrusting his head into his collar, lay down again as though nothing had happened. Why this animal should have chosen to hunt by stratagem prey which it could easily have run down, I cannot suggest; but there can be little doubt that so wise a dog must have had some good reason.

Dunskaith, Ross-shire, Aug. 18 GEORGE J. ROMANES

IN your number of August 14 (Vol. viii. p. 302) Mr. E. C. Buck alluded to the curious and interesting instances of instinct and gregarious action in lower animals, and mentioned that this action has been more particularly observed in the case of wolves in India. These remarks remind me of a curious instance of combined action between two foxes for the capture of their prey, which I witnessed myself more than once; and as similar proceedings, on the part of these animals have been so frequently observed in the hilly country of the department in which I reside, I cannot but conclude that the same habit will prevail among them, wherever they are found. The case is as follows:—One of the two foxes, in the pursuit of a rabbit or hare, continued yelping at short and regular intervals and thus drove the unsuspecting victim in the direction of the appointed bush, where the other fox was concealed and ready to seize its prey as soon as it came within its reach. The capture being effected, they generally divide the prey between them; but if the ambushed fox, in jumping at its prey, has not gained the end in view, the two baffled compeers alternately repeat many times the unsuccessful leap, in order probably to find out the cause of the miscarriage.

The above allusion to foxes leads me to mention another instance of the ingenuity of these animals, which is very remarkable, and one, I believe, which is but little known. On one occasion, in early life, when I happened to pass my College vacation at the Chapelle d'Angillon (Department of the Cher), my attention was attracted twice or three times, when rambling by the side of a small stream called the Petite-Saudre, by a floating mass of moss, which, when drawn to the bank, was found to be swarming with fleas. An old peasant of the neighbourhood, who observed my surprise, gave me the following explanation of the fact, the correctness of which, said he, he could warrant:—Foxes are much tormented with fleas, and when the infliction becomes severe, they gather, from the bark of trees, moss which they carry in their mouths to the side of a stream where the water deepens by degrees. Here, they enter the water, still carrying the moss in their mouths; and, going backwards beginning from the end of their tail, they advance by slow degrees, till the whole body of the animal, with the exception of the mouth, is entirely immersed. The fleas, during this proceeding, have rushed successively in rapid haste to the dry parts and finally to the moss, and the fox, when he has, according to his calculation, allowed sufficient time for all the fleas to take their departure, quietly opens his mouth. The floating moss, with its interesting freight, is carried away by the stream, and the animal finds its way back to the bank, with an evident feeling of much self-satisfaction at having thus freed himself from his tormentors.

Many persons, and very trustworthy ones, confirmed to me the old peasant's account.

Montpellier, Oct. 17 A. PALADILHE

Venomous Caterpillars

ONCE before I wrote to you on this subject, and had hoped that the entomological mountain had long since been safely delivered of its mouse. But from recent communications such appears not to be the case.

Any large caterpillar with tolerably stiff hairs that will not, in different degrees, affect tender skin when brought incautiously in contact, may probably be looked upon as a phenomenon. That any larva with stiff spines will occasion inconvenience by more violent contact is, I should think, evident to any thinking naturalist. That inflammatory symptoms will most probably follow in either case is also evident. The puncture made by a single steel filament would occasion little or no inconvenience; but if multitudes of these filaments were simultaneously directed on a limited surface of skin, the result would be very different. The best analogue of the irritation caused by larval hairs is, as I before hinted, to be found in that following the handling of certain boraginaceous plants—*Echium vulgare*, *Symphytum officinale*, &c.

Mr. Riley, the State Entomologist for Missouri, has, in his fifth annual report, devoted a chapter to this subject, and states that he is acquainted with fifteen indigenous larvæ having so-called urticating powers, and in every instance the action is mechanical. Those observers who place so much stress upon the fact of contact with a hairy larva causing pain should not let surprise get the better of their judgment; nor, in the case of those residing abroad, should they allow themselves to be influenced by native superstitions. The position is simply this: any hairy larva is likely to cause irritation mechanically, from particles of the numerous hairs piercing the skin; no case has yet been proved in which such irritation is the result of *venom*, such as that of *Urtica* among plants.

Lewisham, Oct. 10 R. McLACHLAN

Harmonic Echoes

THE phenomenon mentioned by W. G. M. of notes higher in pitch than the sound producing them being reflected from railings, is not at all uncommon, and is very easy of explanation. Suppose a person standing close to a line of upright bars, the distance between the bars being . a . If he now makes any sharp sound, so as to propagate a single wave, this wave will be successively reflected by each of the bars; so that, in answer to the single wave he propagates, he will have an echo of the pitch corresponding to $\frac{V}{2a}$ vibrations per second (V being the velocity of sound). If, however, he stands at any distance, say κ, from the row of bars, he ought to get a slightly descending echo, as then each wave succeeds the last at a distance increased by twice the difference between $\sqrt{\kappa^2 + n^2 a^2}$ and $\sqrt{\kappa^2 + (n-1)^2 a^2}$, where n is the number of the bar measured from opposite the observer. ARNULPH MALLOCK

Brampford Speke, Oct. 13

Evolution as applied to the Chemical Elements

WHEN so little is really known about evolution, even in the sphere of organic matter, where this grand principle was first prominently brought before our notice, it may perhaps seem premature to pursue its action further back in the history of the universe. However, it seems but natural that we should apply this hypothesis to explain the close connection that holds between certain of the so-called elements. Pre-supposing that this theory has not been discussed before, I will just mention the chief grounds for holding it, and leave the examination into its truth or falsity in the hands of more experienced chemists. Herbert Spencer defines evolution as the integration of matter at the expense of force; this integration being accompanied by a loss of polarity, and by specialisation in a certain direction. Thus much being granted let us see how far this change from simple to complex is traceable in the qualities of certain of the elements, as seen especially in those that fall under natural groups.

In the first place, we may call some of the metals more generalised than others. Thus all hydrogen salts are soluble in water; so, to a less extent, are those of lithium, sodium, and potassium; but as the atomic weight (or mass) increases, so the salts of those metals become less and less soluble. This is only true speaking generally, for we see that, in particular cases, the hydrate of barium is more soluble in water than that of calcium, &c. But, as a rule, the salts of barium are less soluble than those of strontium; these, again, than calcium salts. But, on the whole, we may say that with increase of atomic mass of the metals, their salts lose their general properties and become more and more specialised, the salts taking their character from the metal in combination.

Secondly, according to this hypothesis, increase of atomic mass should be accompanied by absorption of motion. Just as the very complex molecules, of which living organisms are built up, are deficient in polarising or crystallising force, so are also the more massive chemical atoms: for it is evident that the heavy atoms of lead and bismuth have far less of this force, called chemical affinity, than have the light sodium, or the still lighter hydrogen atoms. In colloid bodies, the atomic attractions are mostly used up in keeping together the comparatively great masses of the molecule: hence but little polarity, or attraction among the molecules themselves, is manifested, and the compounds from the union of these molecules are unstable. So, too, the more massive atoms of elements enter with more difficulty into combination, and the products formed are unstable. Thus, the chlorides of platinum, or the oxides of lead, &c., are less stable, and more difficult of formation, than the corresponding salts of potassium or magnesium. Whereas colloids and crystalloids readily unite together: this is paralleled by the strong affinity that hydrogen, or any metal, has for chlorine or oxygen. Here the metal is the light crystalloid, the non-metal, the colloid, so to speak. It is only with the more specialised of the metals, those which we have seen have massive atoms, that hydrogen will unite, viz., antimony and arsenic; and the compound it forms with the former is very unstable, whilst the hydride of bismuth is unknown. These compounds are not alloys like that of hydrogen with palladium, but they show the comparatively non-metallic nature of arsenic and antimony. This consideration leads us to suppose that the non-metals are still more highly evolved than the metals, and that in the special direction towards electro-negative polarity. Besides we know that the intermediate links differ in degree, not in kind.

The lessening of the atomic heat with increase of mass shows a further absorption of motion, besides the potential energy possessed by the more massive atoms. It might be objected that motion has never been extracted from these massive atoms; on the contrary, as a rule, the heat of combustion is greater as atoms of the element entering into combustion are lighter. But the molecules of organic matter must be decomposed by suitable means before they can do any work; just so with the elements, which receive their name for the very reason that, as far as we know, they are incapable of decomposition. Perhaps, indeed, the increase in the number of rays in the spectra of highly heated sulphur and nitrogen will be regarded as an instance of such motion.

Thirdly, if we look at the atomic weight of groups of the elements, it is seen that the increase of mass occurs by a simple proportion. Gladstone, Dumas, Odling and others have shown the close relation of the numbers for particular groups; whilst lately Mendelejeff has given out a law of periodical recurrence, connecting the properties and the atomic weight, either received or theoretical, of all known elementary bodies. Thus we have—

$$\left\{\begin{matrix}\mathrm{Ca} = 40\\ \mathrm{Ba} = 137\end{matrix}\right. \mathrm{Sr} = \frac{40 + 137}{2} = \begin{matrix}88{\cdot}5\\ (\mathrm{Sr} = 87{\cdot}5)\end{matrix}$$

$$\left\{\begin{matrix}\mathrm{Cl} = 35{\cdot}5\\ \mathrm{I} = 127\end{matrix}\right. \mathrm{Br} = \frac{35{\cdot}5 + 127}{2} = \begin{matrix}81{\cdot}25\\ (\mathrm{Br} = 81)\end{matrix}$$

$$\left\{\begin{matrix}\mathrm{Li} = 7\\ \mathrm{K} = 39{\cdot}1\end{matrix}\right. \mathrm{Na} = \frac{7 + 39{\cdot}1}{2} = \begin{matrix}23{\cdot}05\\ (\mathrm{Na} = 23)\end{matrix}$$

These instances suffice to show how near the calculated atomic weights come to those found by experiment.

In the fourth place it is a significant fact, that the elements themselves become changed in properties under different circumstances; the allotropic forms that result may be said to correspond with "varieties" among organised bodies. In the case of the elements greater atomic mass was said to denote evolution; in the best known allotropic varieties we find change from the normal form to be accompanied by increased density. Thus ozone (allotropic oxygen) and red phosphorus have both a greater density than the usual forms of these bodies.

With greater evolution, the so-called elements become more electro-negative; so in these instances, ozone has a greater affinity for hydrogen and the metals than has oxygen, and amorphous phosphorus less affinity for oxygen than ordinary phosphorus.

The varieties of sulphur would seem to be exceptions, for they are of less density than the usual form; the specific gravity of crystallised sulphur is 2·05, that of plastic sulphur, 1·95. However Berthellot terms the crystallised octagonal variety, electro-negative, plastic sulphur, on the contrary, electro-positive. Hence the octagonal form is at once denser and more electro-negative, and should be regarded accordingly as more highly evolved.

In the fifth place, let us note some of the actions and reactions of matter and forces.

(*a*) Heat: In any organic group, generally speaking, the greater the vapour density, accompanying greater complexity, the higher is the boiling point. So it is with the elements, taken according to natural groups, the greater the atomic weight, the higher the fusing or boiling point. This is seen in the case of chlorine, bromine, and iodine; arsenic, antimony, and bismuth, &c. Exceptions to this rule are the three closely allied metals, zinc, cadmium, and mercury, the most volatile of which is the heaviest, the least volatile, the lightest. Again, the more complex the chemical constitution of bodies is, the worse, generally, do they conduct heat and electricity: so too the more highly evolved and massive the atoms, the worse conductors are they as a rule. This applies strictly only to groups, as calcium conducts better than barium or strontium, but silver, though heavier and of greater atomic weight, nearly five times better than calcium. The difference of conducting power between metals and non-metals is very apparent. Where the atomic mass is greater, as the body verges more towards the electro-negative, this loss of conductibility and the high fusing point is easily accounted for by the mechanics of motion. The heavier atom takes longer to communicate its motion in the one case; or is more difficult to move in the other.

Some natural groups of the elements offer good examples of what has just been stated, *e.g.*

	Atomic Weight.	Specific gravity.	Solubility of Salts.	Electric conductivity.
Ca	40·0	1·5	Maximum.	22·14
Sr	87·5	2·5	—	6·71
Ba	137·0	4·5	Minimum.	Minimum.

	Atomic weight.	Physical state.	Chemical activity.	Vapour density.
Cl	35·5	Gas.	Maximum.	2·4
Br	81·0	Liquid.	—	5·4
I	127·0	Solid.	Minimum.	8·7

Hydrogen has the greatest conducting power of all gases. To the principle that lighter atoms have greater polarity or chemical affinity, Bunsen has found an exception, that cesium is heavier and yet more electro-positive than potassium or sodium.

The order of solubility or of chemical activity shows that chlorine and calcium are the more generalised of their respective groups, as we should expect.

(*b*) In the case of Light, not much can be said as yet: but with regard to radiation and absorption of radiant heat, Tyndall has shown that the complex molecules of organic vapours are the best radiators, and that uncombined atoms can hardly be said to radiate or absorb at all. So we see that the simple, "metallic" vapours radiate but ill, whilst the more complex atoms do not reflect, but rather absorb light and heat rays. Indeed, we may suppose, that as in the case of complex vapours, the more highly evolved atoms, requiring a greater supply of force, turn these rays that fall on them to account; whilst the metals dispense with them by reflecting them.

(*c*) The chief relations of electricity have already been alluded to. The chemical affinity between elements increases as they differ in electric polarity; and the more highly evolved, the more chlorous or electro-negative are they.

Lastly, late researches have shown that the elements nitrogen and sulphur at a high temperature, give more complex spectra. This fact, if it be a fact, has thrown some doubt on their claim to be regarded as absolute elements.

In explaining the phenomenon, we should probably consider the sulphur particle to be composed of several groupings of the ultimate element, which, driven apart by the action of heat, are made to vibrate separately with various velocities. Thus the allotropic form of oxygen, ozone, has been represented by a simple formula $\left.\begin{matrix}O\\O\end{matrix}\right\}O$, being made up, as it is supposed, of two groupings of the element oxygen, that being the ultimate atom.

The above statements seem to me to agree in showing, that if the hypothesis of evolution is tenable at all, it can be extended to explain all or nearly all the relations between the elements at present existing on this globe. C. T. BLANSHARD

Queen's College, Oxford

Ancient Balances

Apropos of Mr. Chisholm's interesting account of ancient weighing instruments, in your last number, I venture to call his attention to the representation of an equal-armed balance in an Egyptian papyrus of the nineteenth dynasty, about 1350 B.C. It is to be found in the celebrated "Ritual of the Dead," a hieroglyphical papyrus of Hunnefer, of the reign of Seti I. In the "Judgment Scene" the heart of the deceased is represented as being weighed in a balance in the Hall of Perfect Justice, and in the presence of Osiris. The balance is of the ordinary equal-beam construction, the final adjustment being attained by a sliding weight on one side of the beam, exactly like the "rider" on our exact balances. The papyrus may be seen in the British Museum. G. F. RODWELL

Brilliant Meteors

ON Saturday evening (Oct. 18), about half-past 8 o'clock, I observed, from Boltsburn, Durham, a meteor of considerable brilliancy in the north-western part of the sky; it shot downward from an elevation of about 40°, and left a streak of very red light on its path. The streak continued visible for nine or ten seconds. JOHN CURRY

Boltsburn, Oct. 20

LAST evening, October 26, when returning home I observed a brilliant meteor stream across the sky. It may be worth while to record it.

Not having my watch, I can only guess the time as about 8.20 P.M. The first appearance was like a flash of lightning intensely white, arresting attention at once. When observed it streamed from ξ Persei above Capella (in altitude) and disappeared in Lynx. For two-thirds of its course its light was very bright, and it left a brilliant train of sparks, but for the remaining third it merely showed its own single expiring light.

Later in the evening when observing with the telescope in Cepheus, two shooting stars crossed the field at different times, apparently from the same radiant. T. T. S.

Thruxton Rectory, Hereford

SIR HENRY HOLLAND

ALTHOUGH the late Sir Henry Holland, whose name has been familiar to the world during the greater part of the present century, cannot be regarded as a ma eminent in scientific research, still, as a Fellow of the Royal Society of nearly sixty years' standing, as President of the Royal Institution, as one who was ever ready to contribute towards the advancement of scientific research, and as the friend of all the most eminent men of science of his time, which was a long one, we deem him worthy of more than a passing notice.

As much as for anything else, Sir Henry was known as an indefatigable traveller; his fondness for travelling, indeed, having led to the illness which was the immediate cause of his death on October 27 last, his 86th birthday. He had very early in his career deliberately determined to set aside two months each year for the purpose of indulging his favourite recreation. This year, immediately after his return from a visit to Russia, he set off for Naples in September last, staying a short time at Rome and Paris on his way home. He arrived in London on October 25, suffering from a slight cold, which was sufficient, notwithstanding the wonderful robustness of his constitution, to cut him off in two days. He began his travelling career by a visit to Iceland in 1810, since which he has explored almost every corner of Europe, and been eight times in America. In his "Recollections of Past Life," published in 1872, he speaks thus of his travels:—

"The Danube I have followed with scarcely an interruption, from its assumed sources at Donau-Eschingen to the Black Sea—the Rhine, now become so familiar to common travel, from the infant stream in the Alps to the 'bifidos tractus et juncta paludibus ora' which Claudius with singular local accuracy describes as the end of Stilicho's river journey. The St. Lawrence I have pursued uninterruptedly for nearly 2,000 miles of its lake and river course. The waters of the Upper Mississippi I have recently navigated for some hundred miles below the Falls of St. Anthony. The Ohio, Susquehanna, Potomac, and Connecticut rivers I have followed far towards their sources; and the Ottawa, grand in its scenery of waterfalls, lakes, forests, and mountain gorges, for 300 miles above Montreal. There has been pleasure to me also in touching upon some single point of a river, and watching the flow of waters which come from unknown springs or find their issue in some remote ocean or sea. I have felt this on the Nile at its time of highest inundation, in crossing the Volga when scarcely wider than the Thames at Oxford, and still more when near the sources of the streams that feed the Euphrates, south of Trebizond."

It was mainly on account of the reputation which even then he had achieved as a traveller, that he was elected a Fellow of the Royal Society in 1815.

Sir Henry was elected President of the Royal Institution in 1865, and took the very warmest interest in its success, and in the promotion of scientific research, being seldom or never absent from his post, doing much to popularise science among the upper classes, among whom, as our readers know, he was always a welcome guest. For fifteen years Sir Henry contributed 40*l*. annually to a fund specially set apart for the promotion of research, and was always ready to take by the hand promising young students who were diffident of their own abilities. Sir Henry himself never knew what it was to struggle, no man ever slid more easily into the highest professional and social position, and no man was ever probably less spoiled by his success. He counted from the very first among his patients, many of whom became his intimate friends, the highest in social and political rank both at home and abroad, and the most eminent in literature, science, and art, knew nearly everyone whose name during the last sixty years has been before the public, and was respected and loved by all with whom he came in contact. Sir Henry had naturally good abilities, great tact and knowledge of the world, a mind stored with knowledge gained from books, from travel, and from his intercourse with men, which, combined with his genial